1,171,068

PATENT SPECIFICATION 1,171,068

DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Improvements in or relating to the Treatment of Dispersions.

We, DR. RICHARD EIFERT WIRTSCHAFTSPRUFUNGSGESELLSCHAFT UND STEUERBERATUNGSGESELLSCHAFT MIT BESCHRANKTER HAFTUNG, a German body corporate, of Luisenstrasse 10, D 46 Dortmund, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a method and apparatus for the treatment of a disperse system (i.e. a dispersion), preferably a liquid and more particularly beer, by altering the electric charge on the system, by exposing it to a displacement current field generated by a high-voltage capacitor and discharged pulse-wise between electrodes, the disperse system acting as the electrolyte.

An object of the invention is to provide a method that may be performed at hitherto unusably low temperatures of only approximately 25°C, that is ambient temperature, in order to avoid any deterioration in the taste or colour of the liquids treated, when they are pasteurised and/or sterilised or stabilised so that they will keep longer.

According to one aspect of the present invention there is provided a method of treating a dispersion by altering the electrical charge thereof, which comprises exposing the dispersion to a displacement current field by pulse-wise discharge of a high-voltage capacitor between two electrodes, the dispersion acting as an electrolyte, and exposing the dispersion to strong electromagnetic force(s) in an induction coil.

According to a second aspect of the invention there is provided an apparatus suitable for treating a dispersion by the method described in the preceding paragraph, which comprises means, including a high-voltage capacitor and two electrodes, for exposing the dispersion to displacement current field(s) by force-wise discharge of the high-voltage capacitor between the two electrodes and means, including an induction coil, for exposing the dispersion to strong electromagnetic force(s) in the induction coil.

According to the method of the invention, the dispersion is subjected to strong electromagnetic pulses in at least one induction coil, in order to produce an additional alteration in the electromagnetic charge. According to a further feature of the invention, the method is such that the dispersion is first exposed to the electromagnetic pulses and then to the pulse-wise discharged d.c. fields. According to a further variant of the invention, the disperse systems are exposed to pulse-wise discharged d.c. fields of progressively higher voltage. Herein, the abbreviation "d.c." means the displacement currents which result when capacitors are discharged. The above-mentioned features for the first time enable dispersions, more particularly liquids and preferably beer, to be treated so as to increase their stability without affecting their taste and colour. Any clouding in the liquid, more particularly in beer, is eliminated and subsequent clouding does not occur, since the unstable albuminates which cause the clouding in beer are precipitated after treatment according to the invention and may be removed by filtering or centrifuging. Another substantial advantage of the invention is that the liquids can be treated at, for example, ambient temperature and yet keep for a long time because bacteria therein are made inactive. Dispersoids dissolved in the beer or other

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liquids are precipitated, which effectively eliminates any subsequent clouding. As a result, the liquids are stabilised with respect to colloids and bacteria, besides being pasteurised and/or sterilised.

A further advantage of the invention is that the power required is small, since the process may be carried out at a low temperature (e.g. 25°C) compared with known, conventional processes, where beer and milk are pasteurised at approximately 70°C. The dispersoids precipitated by the method according to the invention may be filtered or centrifuged from the product. The method has the further advantage that it is normally unnecessary to add the usual chemicals to stabilise the beer or other liquids. During the treatment, micro-organisms are damaged so that they can no longer multiply. This is because unicellular and multicellular micro-organisms, such as bacteria, require an ion exchange, e.g. between the nutrient medium and the inside of the organism (the protoplasm) in order to carry out metabolic processes between the organisms and the nutrient medium (e.g. pharmaceuticals, food and luxuries i.e. drinks and confectionery). The ion exchange is caused alternately by charges from positive and negative charge carriers, the anions and cations, building up in the organism. If the cations predominate over the anions, oppositely charged ions can penetrate inside the cell, and vice versa. This charge exchange, and the consequent exchange e.g. of Na^+, K^+, Ca^{++}, Mg^{++} has a far-reaching effect on the general metabolism of micro-organisms and continuously regulates the intra-cellular metabolism. The treatment of liquids according to the invention irreversibly polarises the micro-organisms they contain, with the result that the metabolism is abruptly stopped and the organisms die.

Instead of pasteurising and sterilising the liquids by killing the micro-organisms, the method according to the invention can be used for the opposite purpose of exciting and multiplying e.g. the micro-organisms in an advantageous manner with a relatively low consumption of electricity, e.g. in the manner required for the growth of yeast cultures in the fermentation industry.

Referring now to the apparatus according to the invention, the apparatus preferably comprises a cascade vessel whose cascade partition walls are the electrodes, preferably of carbon, having an induction coil in front, connected to the negative carbon electrodes of the cascade vessel in series to earth. According to a further feature of the invention, the apparatus may be constructed so that the positive, preferably carbon, electrodes near the outlet nozzle in the direction of flow of the dispersion for treatment in the cascade vessel can be connected and disconnected by a switch, preferably a gas discharge vessel comprising at least one high-voltage capacitor, and the positive, preferably carbon, electrodes near the inlet nozzle in the direction of flow of the dispersion for treatment in the cascade vessel are each earthed through a capacitor, the capacitors being charged by the dispersion acting as electrolyte, using the voltage remaining from the previous discharge of the high-voltage capacitor(s).

The apparatus according to the invention is simple and inexpensive in construction. In cascade form, it can be added to or reduced by the building-block method in accordance with operational needs, with the result that the method according to the invention is carried out with maximum efficiency. An important feature is that only some of the positive carbon electrodes are charged from high-voltage capacitors, whereas the other positive carbon electrodes are each connected to earth via a capacitor, with the result that in this region also, additional, weaker pulse-wise discharges occur without any additional power consumption.

Another advantageous embodiment of the apparatus according to the invention is characterised by a number of cascade vessels connected in parallel and/or in series and forming loops. An associated, advantageous feature is characterised by a number of groups of cascade vessels connected in parallel and/or in series.

The aforementioned features have the advantage of increasing the qualitative and quantitative performance and efficiency of the plant, and of varying them in the optimum manner to suit particular cases.

According to another feature of the invention, the apparatus for performing the method according to the invention can be constructed so that a cascade vessel is made up of at least three similar, annular, non-conducting pressure elements with a front and rear sealing-tight cover and each pressure element has an electrode, preferably a carbon electrode, acting as a partition wall. According to another advantageous feature, the pressure elements are made of a plastics material, preferably polyethylene, and do not have any chemical action on food or luxuries. It is also desirable that the non-conducting pressure elements should be protected on the outside with a steel casing ring, and that each pressure element should have an outlet for sediment.

The aforementioned features have the substantial advantage of reliably preventing a flashover of the electric charge onto the walls of the cascade vessel. This is achieved by constructing the cascade vessel from non-conducting pressure elements which prevent the applied electric voltage from flashing over. The aforementioned features affect

the construction, in that the cascade vessel is formed of identical pressure elements which can be mass-produced and are therefore cheap. Furthermore, each cascade vessel can be built up to any required size by the building-block method. Individual pressure elements can be interchanged, with the result that they can easily be stored as a stock of spare parts can be kept.

Since the pressure elements are preferably made of plastics material which does not have any chemical effect on food and luxuries, they can be used for the treatment of specially sensitive food and luxuries, such as beer.

The external steel casing ring for protecting the pressure elements provides an electric screen against leakage fields and also gives mechanical protection.

A sediment outlet for each pressure element is particularly advantageous for the electrical treatment, since the sediment can be withdrawn from each chamber as it precipitates and can be further processed.

According to a further feature of the invention, the cascade vessel or vessels can have a degassing valve and sight-glass on the same side as the outlet nozzle. Any gas bubbles formed during the process according to the invention can easily be detected and removed by the degassing valve and sight-glass, which is known as a "lantern" in the treatment of beer.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which Figure 1 shows a diagrammatic plan view of an apparatus according to the invention without positive electrodes but with negative electrodes in position,

Figure 2 shows a side view of the apparatus of Figure 1, with positive and negative electrodes,

Figure 3 shows a circuit for the apparatus of Figures 1 and 2.

Figure 4 shows a variant of the apparatus in Figure 1, with cascade groups,

Figure 5 shows a side view of an apparatus according to the invention comprising a cascade vessel made up of pressure elements,

Figure 6 shows a plan view of the apparatus of Figure 5,

Figure 7 shows a section along line VII—VII in Figure 5, and

Figure 8 shows a section through two pressure elements along line VIII—VIII in Figure 7.

Referring now to Figures 1 to 3 of the drawings, the liquid, e.g. beer, for treatment is fed through an inlet pipe 10 and an induction coil 11 into the apparatus. The coil 11 is made from a plastics material cylinder 11*a* and a winding 11*b* of insulated copper wire.

The liquid for treatment flows through the cylinder 11*a* and an inlet nozzle 19 into a closed, pressure-tight cascade vessel 12. The cascade vessel 12 has internal partition walls 13_{1-6}, 14_{1-5}, made of carbon and acting as carbon electrodes. The liquid flows round the cascade partition walls 13, 14 in the direction shown by arrows A through the labyrinthine paths inside the cascade vessel 12 and comes out at an outlet nozzle 15 after treatment. The lower walls 13_1, 13_2, 13_3, 13_4, 13_5 and 13_6 are attached to the bottom 12*a* of the vessel 12. The upper walls 14_1, 14_2, 14_3, 14_4, 14_5 are insulated from and attached to the lid 12*b* of the vessel 12, e.g. by means of insulating globes 16. The vessel 12 is supported by insulated legs 18 on floor 17. The vessel 12 has a degassing valve and a sight-glass 22 on the same side as its outlet nozzle 15.

The electrical circuit of the apparatus is shown in Figure 3 and comprises positive carbon electrodes 14_5, 14_4 near the outlet end (15) in the direction of flow of the fluid treated in cascade vessel 12, which can be connected or disconnected by a switch 20, preferably a gas discharge vessel, with at least one high-voltage capacitor C. The positive carbon electrodes 14_3, 14_2, 14_1 at the inlet end (19) in the direction of flow of the fluid treated in cascade vessel 12 are earthed through capacitors C_3, C_2, C_1 respectively. The partition walls 13_1–13_6 are the negative carbon electrodes and earthed by a line 21 through the winding 11*b*. The capacitors C_3, C_2, C_1 are charged by the liquid under treatment, acting as electrolyte, from the voltage which remains after the high-voltage capacitor C has been discharged and which dies away exponentially in the series of the capacitors C_3, C_2, C_1.

The number of carbon electrodes 13_1–13_6 and 14_1–14_5 and the number of high-voltage capacitors C or C_3, C_2, C_1 can be varied as required, depending on the dispersion for treatment, preferably beer or other liquids such as milk or similar beverages.

The liquid treated is first acted on electromagnetically in the induction coil 11 and then acted on electrically in the cascade vessel 12. The electromagnetic fields of coil 11 build up and decrease pulse-wise at the same time as the high-voltage capacitor C is discharged. The same applies to the charging and discharging of capacitors C_3, C_2, C_1. The combined magnetic and d.c. fields acting successively on the liquids treated produce an anionic or cationic charge in the amphoteric particles in the liquids. The resulting coagulates formed in the liquid may be removed by filters or centrifuges not shown in the drawing.

As Figure 4 shows, the apparatus may be

constructed with a number of cascade vessels 12_I, 12_{II}–12_{VI} connected in parallel and/or in series and forming groups X, Y... A number of groups X, Y can also be provided, connected in parallel and/or in series. The example in Figure 4 shows two groups X, Y in parallel.

Referring now to Figures 5 to 8 of the drawings, the cascade vessel 12 comprises a multiplicity — that is, at least three — of identical, annular, non-conducting pressure elements 23 with a front (24) and a rear (25) sealing cover.

The pressure elements 23 are suspended at each end by lugs 28 on tension rods 29 connected to lock-nuts 41, via cross-pieces 30. A pressure spindle 31 and a hand wheel 32 engage in each member 30 and press the elements 23 together in sealing-tight manner by means of sealing-tight covers 24 and 25. The elements 23 thus co-operate with the covers 24, 25 to form vessels 12. The cross-pieces 30 rest on legs 18.

The liquid for treatment is fed in through a feed pipe 10, from which it passes through a plastics material cylinder 11*a*, a coil 11*b* and an inlet nozzle 19 through the cover 24 into the cascade vessel 12. A sight-glass 33 can be disposed in pipe 10, and a sight-glass 34 can be disposed in outlet nozzle 15.

The pressure elements 23 are made of a plastics material, preferably polyethylene, which does not have any chemical effect on food and luxuries. As shown in Figures 7 and 8, the elements 23 are protected externally by a steel casing ring 26. Each element 23 has a sediment outlet 27.

Each element 23 also has a carbon electrode serving as a partition wall 13_{1-6} or 14_{1-5}. Each electrode is connected to an external electrode connection 36 by means of a carbon rod 35. Lines from capacitors C or C_1, C_2, C_3, or lines to earth are connected to electrode connections 36, as shown in Figure 3.

In order to convey the liquid, each pressure element 23 has an inlet 37 in the form of an opening and, at the opposite end, an overflow duct 38 connected to an annular duct 39 which conveys the liquid to an outlet 40 at the opposite end. Outlet 40 co-operates with inlet 37 of the next pressure element. As Figure 7 shows, each pressure element can have two inlets 37 and two corresponding outlets 40.

WHAT WE CLAIM IS:—

1. A method of treating a dispersion by altering the electrical charge thereof, which comprises exposing the dispersion to a displacement current field by pulse-wise discharge of a high-voltage capacitor between two electrodes, the dispersion acting as an electrolyte, and exposing the dispersion to strong electro-magnetic force(s) in an induction coil.

2. A method according to Claim 1, wherein the dispersion is first exposed to the electromagnetic force(s) and then to the pulse-wise discharge displacement current field.

3. A method according to Claim 1 or 2, wherein the dispersion is exposed to a series of pulse-wise discharge displacement current fields of progressively higher voltage.

4. A method according to Claim 1, 2 or 3, which comprises treating a liquid dispersion.

5. A method according to Claim 4, which comprises treating beer, whereby any dispersoid(s) in the beer is (are) eliminated by coagulation thereof and removal of the coagulate(s) by filtration or centrifugation, and subsequent formation of dispersoid(s) is substantially prevented.

6. A method according to any one of the preceding claims, in which any bacteria present in the dispersion are made inactive.

7. A method according to any one of Claims 1 to 5, wherein micro-organisms in the dispersion are excited and multiply, in the manner required for the growth of yeast cultures.

8. A method according to any one of the preceding claims, wherein the dispersion is treated at ambient temperature.

9. A method according to any one of the preceding claims, wherein the high-voltage capacitor is discharged between two carbon electrodes.

10. A method in accordance with Claim 1, substantially as hereinbefore described with reference to Figures 1, 2, 3 and 4 of the accompanying drawings.

11. A method in accordance with Claim 1, substantially as hereinbefore described with reference to Figures 5, 6, 7 and 8 of the accompanying drawings.

12. An apparatus suitable for treating a dispersion by the method claimed in Claim 1, which comprises means, including a high-voltage capacitor and two electrodes, for exposing the dispersion to displacement current field(s) by force-wise discharge of the high voltage capacitor between the two electrodes and means, including an induction coil, for exposing the dispersion to strong electromagnetic force(s) in the induction coil.

13. An apparatus according to Claim 12, wherein the electrodes are carbon electrodes.

14. An apparatus according to Claim 12 or 13, which comprises a cascade vessel, the partition walls of which form the electrodes, with the induction coil being connected to the negative carbon electrode(s) of the cascade vessel in series to earth.

15. An apparatus according to Claim 14, including means for disconnecting and

connecting into the circuit the positive electrode(s) near the outlet of the cascade vessel, the positive electrode(s) near the inlet of the cascade vessel being earthed through a capacitor, such that the capacitor(s) can be charged by the dispersion acting as an electrolyte, using the voltage remaining from the previous discharge of the high-voltage capacitor.

16. An apparatus according to Claim 15, wherein the switching means comprises a gas discharge vessel and at least one high-voltage capacitor.

17. An apparatus according to Claim 14, 15 or 16 which comprises a number of cascade vessels connected in parallel and/or in series.

18. An apparatus according to Claim 17, comprising a number of groups of cascade vessels connected in parallel and/or in series.

19. An apparatus according to any one of Claims 14 to 18, wherein the or each cascade vessel is provided with a degassing valve and a sight-glass on the same side as the outlet thereof.

20. An apparatus according to any one of Claims 14 to 19, wherein the or each cascade vessel comprises at least three similar, annular, non-conducting pressure elements and a front and a rear sealing cover, each pressure element having an electrode acting as a partition wall.

21. An apparatus according to Claim 20, wherein the pressure elements are made of a plastics material.

22. An apparatus according to Claim 21, wherein the plastics material is polyethylene.

23. An apparatus according to Claim 20, 21 or 22, wherein the pressure elements are protected by an external steel casing ring.

24. An apparatus according to any one of Claims 20 to 23, wherein each pressure element is provided with a sediment outlet.

25. An apparatus according to Claim 12, substantially as hereinbefore described with reference to, and as shown in Figures 1 to 3 of the accompanying drawings.

26. An apparatus according to Claim 12, substantially as hereinbefore described with reference to, and as shown in Figure 4 of the accompanying drawings.

27. An apparatus according to Claim 12, substantially as hereinbefore described with reference to, and as shown in Figures 5 to 8 of the accompanying drawings.

28. A dispersion whenever treated by the method or in the apparatus claimed in any preceding claim.

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1171068 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig.1

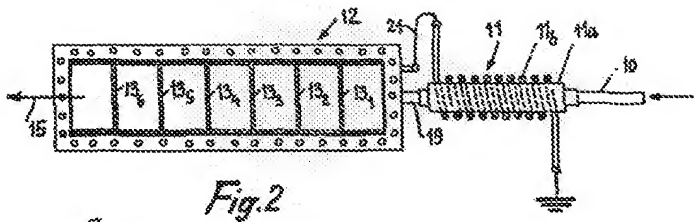


Fig.2

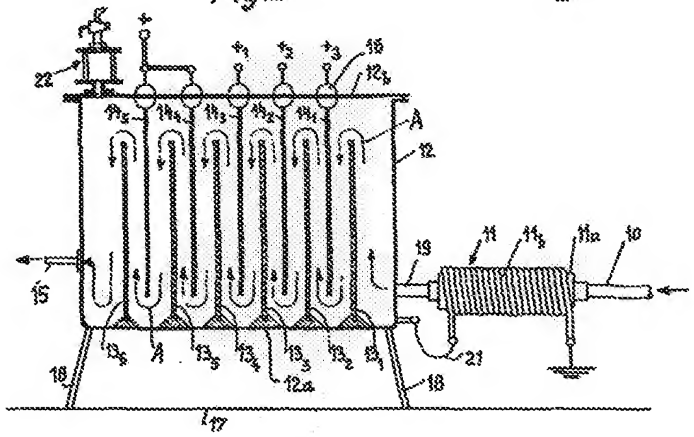
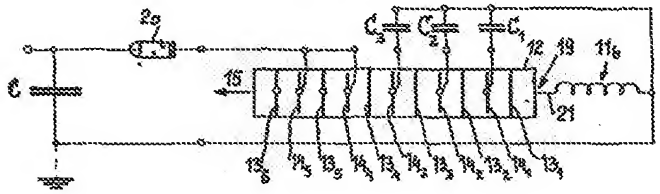
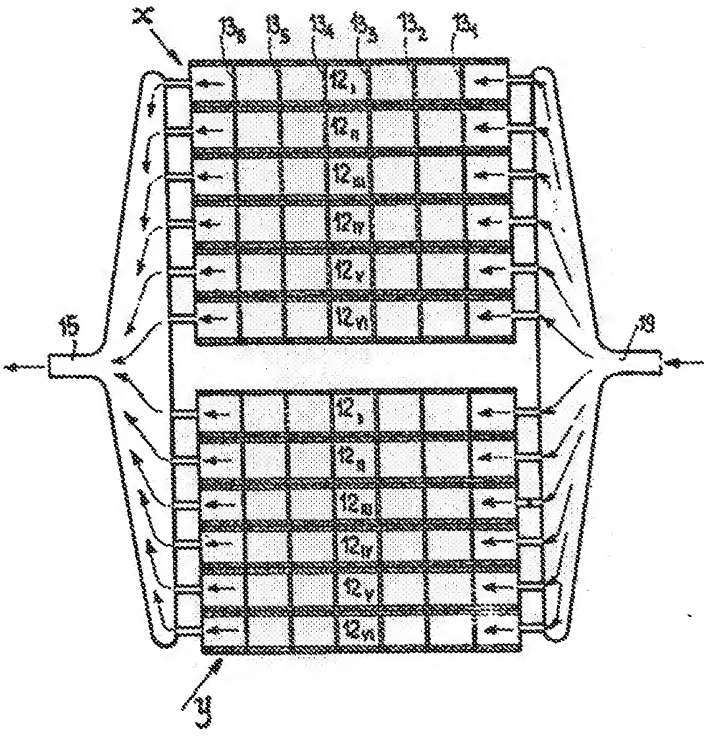


Fig.3



1171068 COMPLETE SPECIFICATION
3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

Fig. 4



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3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 3

Fig.5

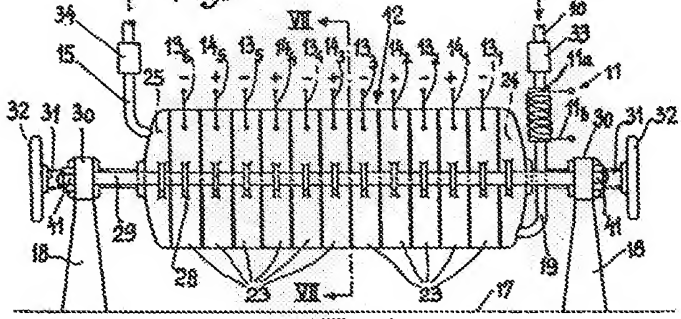

Fig.6

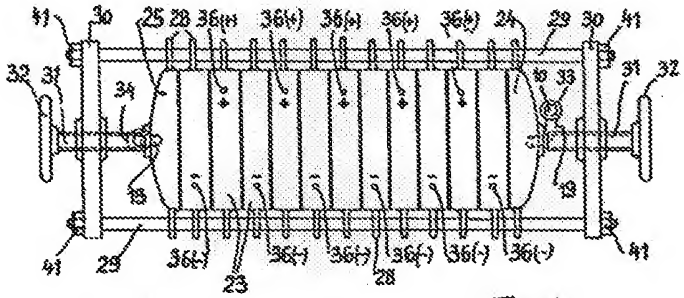

Fig.7

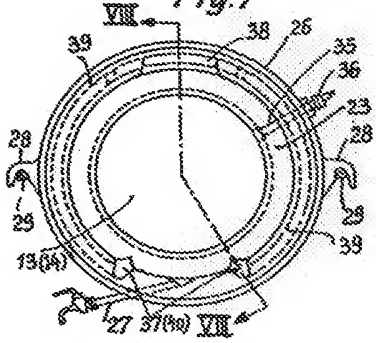

Fig.8